New Hampshire Volunteer Lake Assessment Program

2003 Biennial Report for
Suncook Ponds
Barnstead

NHDES
Water Division
Watershed Management Bureau
29 Hazen Drive
Concord, NH 03301

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **SUNCOOK PONDS, BARNSTEAD,** the program coordinators have made the following observations and recommendations:

We would like to thank your group for sampling your ponds once this summer. However, we would like to encourage your monitoring group to sample additional times each summer. Typically we recommend that monitoring groups sample three times per summer (once in June, July, and August). We understand that the number of sampling events you decide to conduct per summer will depend upon volunteer availability, your monitoring group's water monitoring goals and funding availability. However, with a limited amount of data it is difficult to determine accurate and representative water quality trends. Since weather patterns and activity in the watershed can change throughout the summer, from year to year, and even from hour to hour during a rain event, it is a good idea to sample the lake/pond at least once per month over the course of the season.

If you are having difficulty finding volunteers to help sample, or to pick-up or drop-off equipment at one of the laboratories, please give the VLAP Coordinator a call and we will try to help you work out an arrangement.

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the pond has been monitored through the program.

  Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity.

The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 mg/m^3.

LOWER SUNCOOK POND

The current year data (the top graph) show that the chlorophyll-a concentration in September was ***less than*** the state mean.

Overall, visual inspection of the historical data trend line (the bottom graph) shows ***a relatively stable*** in-lake chlorophyll-a trend, meaning that the concentration has ***remained approximately the same, although with some fluctuation,*** since monitoring began.

UPPER SUNCOOK POND

The current year data (the top graph) show that the chlorophyll-a concentration in September was ***less than*** the state mean.

Overall, visual inspection of the historical data trend line (the bottom graph) shows ***a stable*** in-lake chlorophyll-a trend, meaning that the concentration has ***remained approximately the same*** since monitoring began.

After **10 consecutive** years of sample collection, we will be able to conduct a statistical analysis of the historic data to objectively determine if there has been a significant change in the annual mean chlorophyll-a concentration since monitoring began.

While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Algal concentrations may increase with an increase in nonpoint sources of phosphorus loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). Therefore, it is extremely important for volunteer monitors to continually educate residents about how activities within the watershed can affect phosphorus loading and lake/pond quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for pond transparency. Table 3 (Appendix B) lists the maximum, minimum and mean transparency data for each sampling season that the pond has been monitored through the program.

  Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.**

LOWER SUNCOOK POND

The current year data (the top graph) show that the in-lake transparency in September was ***approximately equal to*** the state mean.

Overall, visual inspection of the historical data trend line (the bottom graph) shows ***a stable*** trend for in-lake transparency, meaning that the transparency has ***remained approximately the same*** since monitoring began.

UPPER SUNCOOK POND

The current year data (the top graph) show that the in-lake transparency in September was ***less than*** the state mean.

Overall, visual inspection of the historical data trend line (the bottom graph) shows ***a variable*** trend for in-lake transparency, meaning that the transparency has ***fluctuated*** since monitoring began.

After **10 consecutive** years of sample collection, we will be able to conduct a statistical analysis of the historic data to objectively determine if there has been a significant change in the annual mean transparency since monitoring began.

Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the pond has joined the program.

  Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a pond can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

  LOWER SUNCOOK POND

  The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration in September was ***approximately equal to*** the state median.

  The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration in September was ***approximately equal to*** the state median.

  Overall, visual inspection of the historical data trend line for the epilimnion show ***a relatively stable*** phosphorus trend, which means that the concentration has ***remained approximately the same*** in the epilimnion since monitoring began.

  Overall, visual inspection of the historical data trend line for the hypolimnion shows ***a variable*** phosphorus trend, which means that the concentration has ***fluctuated*** in the hypolimnion since monitoring began.

  UPPER SUNCOOK POND

  The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration in September was ***greater than*** the state median.

  The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration in September was ***greater than*** the state median.

Overall, visual inspection of the historical data trend line for the epilimnion shows ***a variable*** phosphorus trend, which means that the concentration has ***fluctuated*** in the epilimnion since monitoring began.

Overall, visual inspection of the historical data trend line for the hypolimnion shows ***a relatively stable*** phosphorus trend, which means that the concentration has ***remained approximately the same*** in the hypolimnion since monitoring began.

After **10 consecutive** years of sample collection, we will be able to conduct a statistical analysis of the historic data to objectively determine if there has been a significant change in the annual mean phosphorus concentration since monitoring began.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands.

TABLE INTERPRETATION

- **Table 2: Phytoplankton**

Table 2 (Appendix B) lists the current and historic phytoplankton species observed in the pond.

LOWER SUNCOOK POND

The dominant phytoplankton species observed this year were ***Tabellaria*** **(Diatom),** ***Anabaena*** **(Cyanobacteria), and** ***Microcystis*** **(Cyanobacteria).**

UPPER SUNCOOK POND

The dominant phytoplankton species observed this year were ***Microcystis*** **(Cyanobacteria),** ***Tabellaria*** **(Diatom), and** ***Anabaena*** **(Cyanobacteria).**

Phytoplankton populations undergo a natural succession during the growing season (Please refer to the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds.

An overabundance of cyanobacteria (previously referred to as blue-green algae) indicates that there may be an excessive total phosphorus concentration in the pond, or that the ecology is out of balance. Some species of cyanobacteria can be toxic to livestock, pets, wildlife, and humans. (Please refer to the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding cyanobacteria).

- **Table 2: Cyanobacteria (Blue-green algae)**
  Small amounts of the cyanobacterium ***Microcystis*** **and** ***Anabaena*** were observed in the plankton sample this season. ***These species, if present in large amounts, can be toxic to livestock, wildlife, pets, and humans.***

  Cyanobacteria can reach nuisance levels when excessive nutrients and favorable environmental conditions occur. During September of 2003, a few lakes and ponds in the southern portion of the state experienced cyanobacteria blooms. This was likely due to nutrient loading to these waterbodies. As mentioned previously, many weeks during the Spring and Summer of 2003 were rainy, which likely resulted in a large amount of nutrient loading to surface waters.

  The presence of cyanobacteria serves as a reminder of the pond's delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading into the pond by eliminating fertilizer use on lawns, keeping the pond shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

  In addition, residents should also observe the pond in September and October during the time of fall turnover (lake mixing) to document any algal blooms that may occur. Cyanobacteria (blue-green algae) have the ability to regulate their depth in the water column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to "pile" cyanobacteria into scums that accumulate in one section of the pond. If a fall bloom occurs, please contact the VLAP Coordinator.

- **Table 4: pH**
  Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

  pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.5**, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

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The mean pH at the deep spot this season ranged from **6.51** in the hypolimnion to **6.42** in the epilimnion, which means that the water is ***slightly acidic.***

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The mean pH at the deep spot this season ranged from **6.0** in the hypolimnion to **6.6** in the epilimnion, which means that the water is ***slightly acidic.***

Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake/pond pH.

- **Table 5: Acid Neutralizing Capacity**
  Table 5 (Appendix B) presents the current year and historic epilimnetic ANC for each year the pond has been monitored through VLAP.

  Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. The mean ANC value for New Hampshire's lakes and ponds is **6.7 mg/L**, which indicates that many lakes and ponds in the state are "highly sensitive" to acidic inputs. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

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The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) continues to remain ***much less than*** the state mean of **6.7 mg/L**. Specifically, the pond is classified by DES as ***highly sensitive*** to acidic inputs (such as acid precipitation).

UPPER SUNCOOK POND

The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) continues to remain ***much less than*** the state mean of **6.7 mg/L**. Specifically, the pond is classified by DES as ***highly sensitive*** to acidic inputs (such as acid precipitation).

- **Table 6: Conductivity**
  Table 6 (Appendix B) presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. The mean conductivity value for New Hampshire's lakes and ponds is **62.1 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

  The conductivity in the pond is relatively ***low*** and ***less than*** the state mean. Typically conductivity levels greater than 100 uMhos/cm indicate the influence of human activities on surface water quality. These activities include septic system leachate, agricultural runoff, iron deposits, and road runoff (which contains road salt during the spring snow melt). The low conductivity level in the pond is an indication of the low amount of pollutants in the watershed. We hope this trend continues!

- **Table 8: Total Phosphorus**
  Table 8 (Appendix B) presents the current year and historic total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

  We would like to suggest that the volunteers collect samples again at the numerous tributaries to the ponds. In the past, several of these tributaries have experienced high levels of total phosphorus. If this trend continues, it would be wise to conduct stream surveys at these sites.

- **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**
  Table 9 (Appendix B) shows the dissolved oxygen/temperature profile(s) for the 2003 sampling season. Table 10 (Appendix B) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

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The dissolved oxygen concentration was ***high*** at all depths sampled at the deep spot of the pond. Typically, shallow lakes and ponds that are not deep enough to stratify into more than one or two layers will have relatively high amounts of oxygen at all depths. This is due to continual lake mixing and diffusion of oxygen into the bottom waters induced by wind and wave action.

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During this season, and many past sampling seasons the pond has had a lower dissolved oxygen concentration and a higher total phosphorus concentration in the hypolimnion (the lower layer) than in the epilimnion (the upper layer). These data suggest that the process of ***internal phosphorus loading*** is occurring in the pond or that the lake bottom was disturbed by the Kemmerer Bottle or the anchor while sampling.

When oxygen levels are depleted to less than 1 mg/L in the hypolimnion **(as it was this season and in many past seasons)**, the phosphorus that is normally bound up with metals in the sediment may be re-released into the water column. Depleted oxygen concentration in the hypolimnion of thermally stratified lakes/ponds typically occurs as the summer progresses.

The depleted dissolved oxygen concentration in the hypolimnion may explain why the phosphorus concentration in the hypolimnion is ***greater*** than the phosphorus concentration in epilimnion. Since an internal source of phosphorus in the pond may be present, it is even more important that watershed residents act proactively to minimize external phosphorus loading from the watershed.

We suggest scheduling the 2004 biologist visit for **June**. This will allow us to conduct an oxygen profile to determine if the dissolved oxygen levels are low as well in the early part of the summer.

- **Table 11: Turbidity**
  Table 11 (Appendix B) lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the "Other Monitoring Parameters" section of this report for a more detailed explanation.

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The turbidity of the hypolimnion (lower layer) sample was elevated on **September 10**. This suggests that the process of internal loading was occurring in the pond or that the lake bottom was disturbed while sampling (see the discussion in the Total Phosphorus section above).

DATA QUALITY ASSURANCE AND CONTROL

Annual Assessment Audit:

During the annual visits to lakes and ponds, the biologist typically conducts a "Sampling Procedures Assessment Audit" for each monitoring group. Specifically, the biologist observes the performance of your monitoring group while sampling and fills out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor's Field Manual). This assessment is used to identify any aspects of sample collection in which volunteer monitors are not following the proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Since this was the first season your particular group sampled the pond, the audit was not conducted at your pond in 2003. If it had been, these are the general activities that would have been assessed:

- **Finding the deep spot:** Please remember to locate the deep spot using three reference points from the shoreline. This method is known as ***triangulation***. In addition, depth finders and Global Positioning System (GPS) technology may be used to further pinpoint the location of the deep spot. In addition, please remember to check the depth of the deep spot by ***sounding*** to ensure that you have actually located the deepest spot. To sound the bottom, simply fill the Kemmerer bottle with lake water from the surface and then lower the bottle into the lake until you feel it touch the bottom. When you have reached the bottom, check the depth on the calibrated chain. You may need to move to another location and repeat this procedure a few times until the deepest spot is located. When you have found the deep spot, please remember to write the depth of the field data sheet. **Sounding may disturb the sediment, so please allow the bottom to settle out before collecting the deepest sample.**

- **Anchoring at deep spot:** Please remember to use an anchor with sufficient weight and sufficient amount of rope to prevent the boat from drifting while sampling at the deep spot. It is difficult for the biologist to collect an accurate and representative dissolved oxygen/temperature profile when the boat is drifting. In addition, it is difficult to view the secchi disk and collect samples from the proper depths when the boat is drifting. Depending on the depth of the lake/pond and the wind conditions, it may be necessary to use two anchors!

- **Hypolimnion (lower layer) sample collection:** Always remember to allow the lake/pond bottom to settle after you sound the bottom before collecting the hypolimnion (lower layer) sample. In addition, please be careful not to hit the lake/pond bottom and make sure that there is no sediment in the Kemmerer bottle before filling the sample bottles. When the lake/pond bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column.

- **Secchi disk readings:** When measuring the transparency at the deep spot, please remember to take **at least two** secchi disk readings. Since the depth to which the secchi disk can be seen in the water column can vary depending on how windy or sunny it is, and also on the eyesight of the volunteer monitor, it is best to have at least two people take a reading. In addition, please make sure that the readings are taken on the shady, non-windy side of the boat, between the hours of 10 am and 2 pm.

- **Chlorophyll-a Sampling:** When collecting the chlorophyll-a sample using the **integrated tube method**, please make sure to lower both the weighted end and chain to the appropriate sample depth. Specifically, in lakes with one or two thermal layers, lower the weighted end and chain to 2/3 the total depth. In lakes with three layers, lower the weighted end and the chain to the middle of the middle layer (metalimnion). Crimp the end of the tube tightly and haul the weighted end up *by the chain only.* Lift the *uncrimped* end above your head so the open end is always higher than the water level in the tube to ensure that the sample does not escape out of the top of the tube.

- **Tributary Sampling:** Please do not sample tributaries that are too shallow to collect a “clean” sample (i.e.; free from sediment and organic debris). You may need to move upstream or downstream to collect a “clean” sample. If the stream is not deep enough and the bottom sediment is disturbed while sampling, the phosphorus concentration in the sample will likely be elevated.

In addition, please do not sample tributaries if the bottom sediment has been disturbed as this will likely result in an elevated phosphorus concentration. If you disturb the stream bottom while sampling, please rinse out the bottle and move to an upstream location so that you can sample in an undisturbed area.

USEFUL RESOURCES

Acid Deposition Impacting New Hampshire's Ecosystems, ARD-32, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/ard/ard-32.htm.

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, *NHDES-WD 97-8*, NHDES Booklet, (603) 271-3503.

Camp Road Maintenance Manual: A Guide for Landowners. KennebecSoil and Water Conservation District, 1992, (207) 287-3901.

Comprehensive Shoreland Protection Act, RSA 483-B, *WD-SP-5,* NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-5.htm.

Erosion Control for Construction in the Protected Shoreland Buffer Zone, WD-SP-1, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-1.htm

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, *WD-BB-9*, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-9.htm.

Management of Canada Geese in Suburban Areas: A Guide to the Basics, Draft Report, NJ Department of Environmental Protection Division of Watershed Management, March 2001, www.state.nj.us/dep/watershedmgt/DOCS/BMP_DOCS/Goosedraft.pdf.

Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-2.htm.

Road Salt and Water Quality, WD-WMB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/wmb/wmb-4.htm.

Sand Dumping - Beach Construction, *WD-BB-15*, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-15.htm.

Through the Looking Glass: A Field Guide to Aquatic Plants. North American Lake Management Society, 1988, (608) 233-2836 or www.nalms.org.

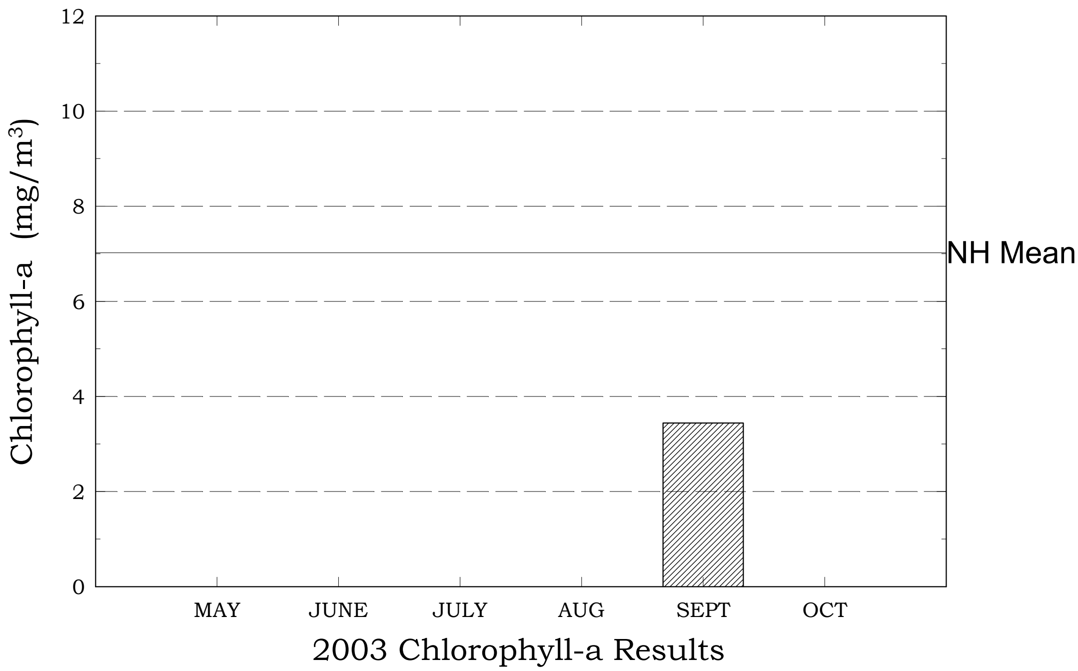
Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-4.htm.

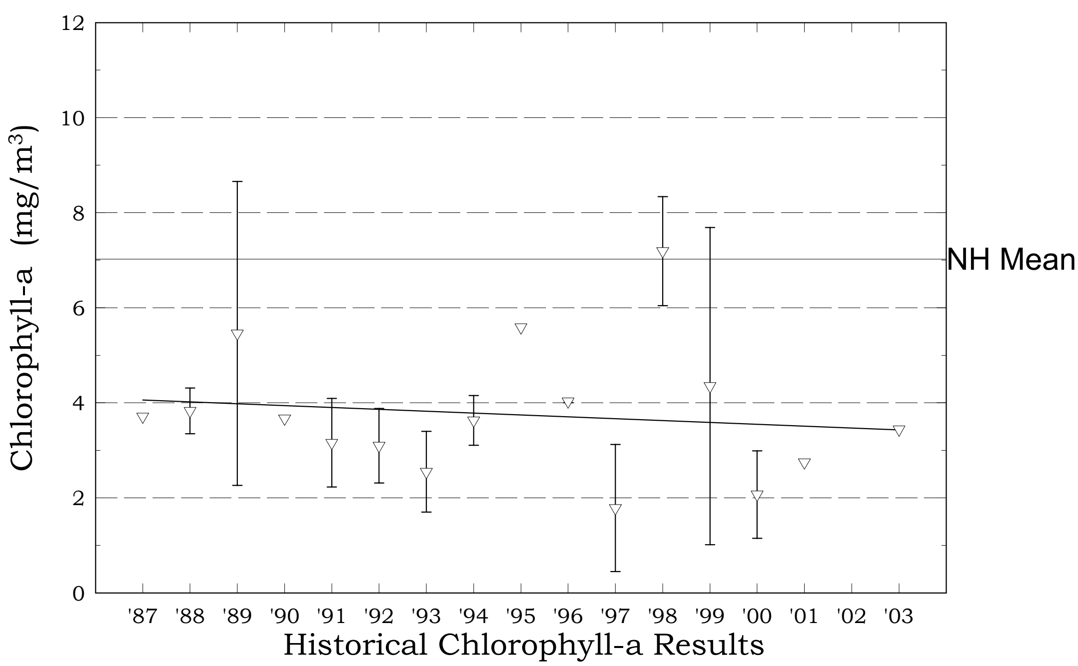
APPENDIX A

GRAPHS

Lower Suncook Pond, Barnstead

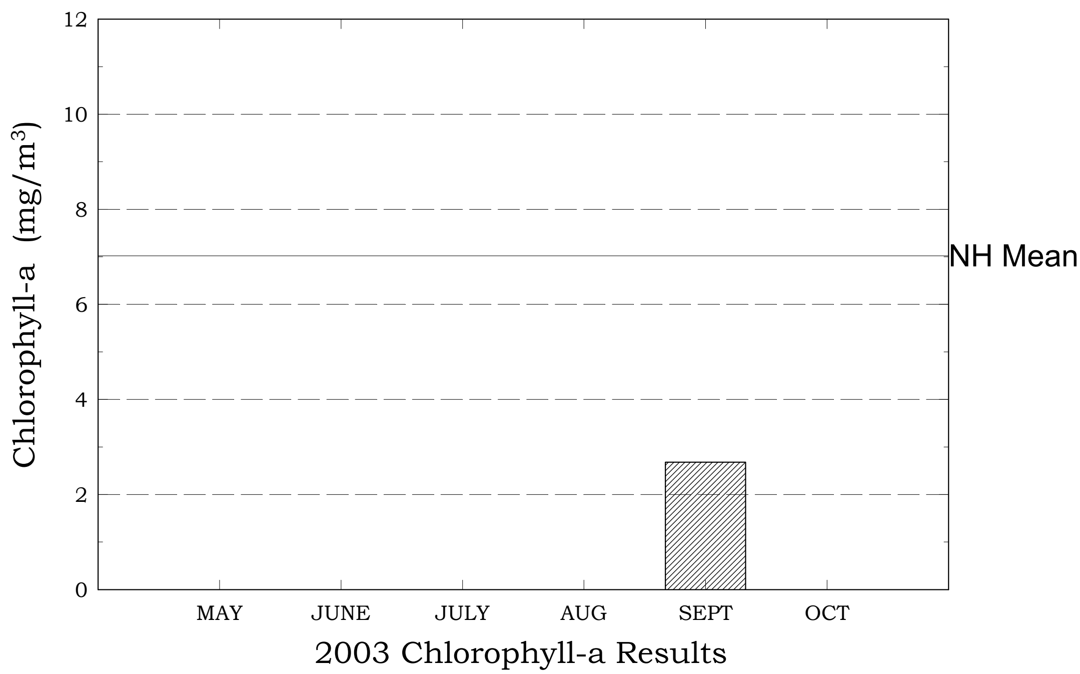
Figure 1. Monthly and Historical Chlorophyll-a Results

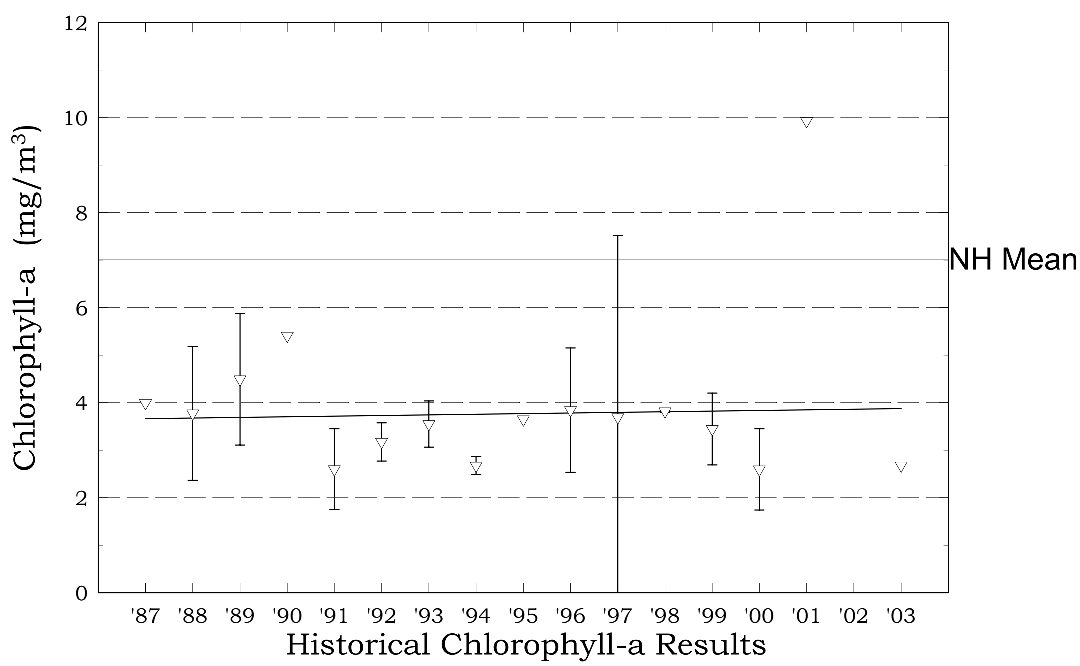




Upper Suncook Pond, Barnstead

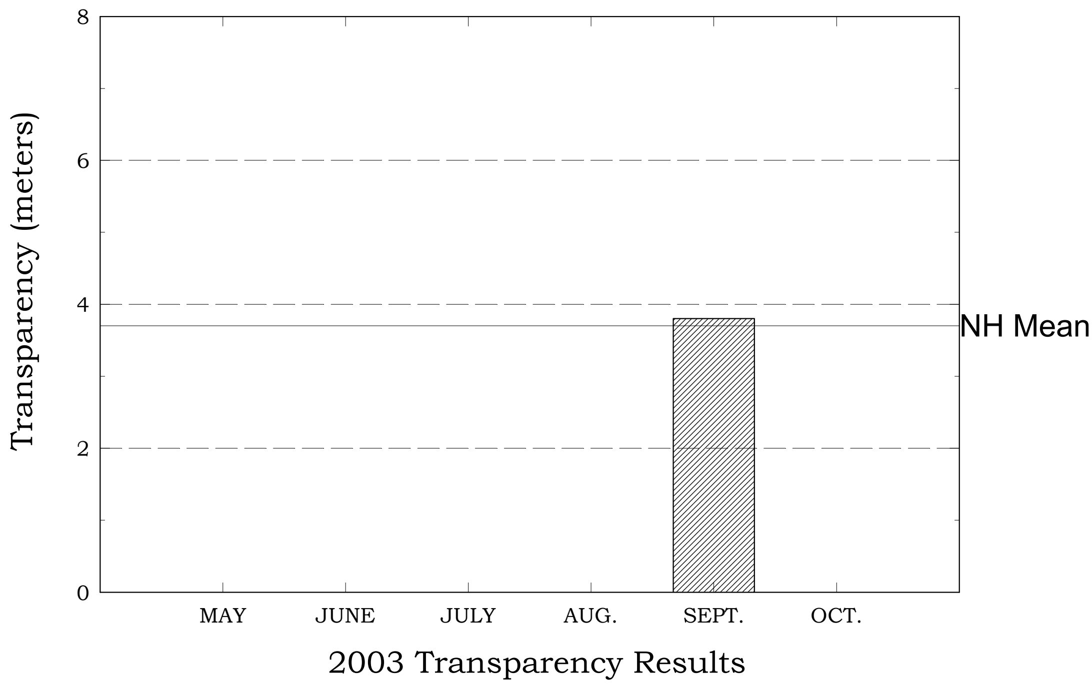
Figure 1. Monthly and Historical Chlorophyll-a Results

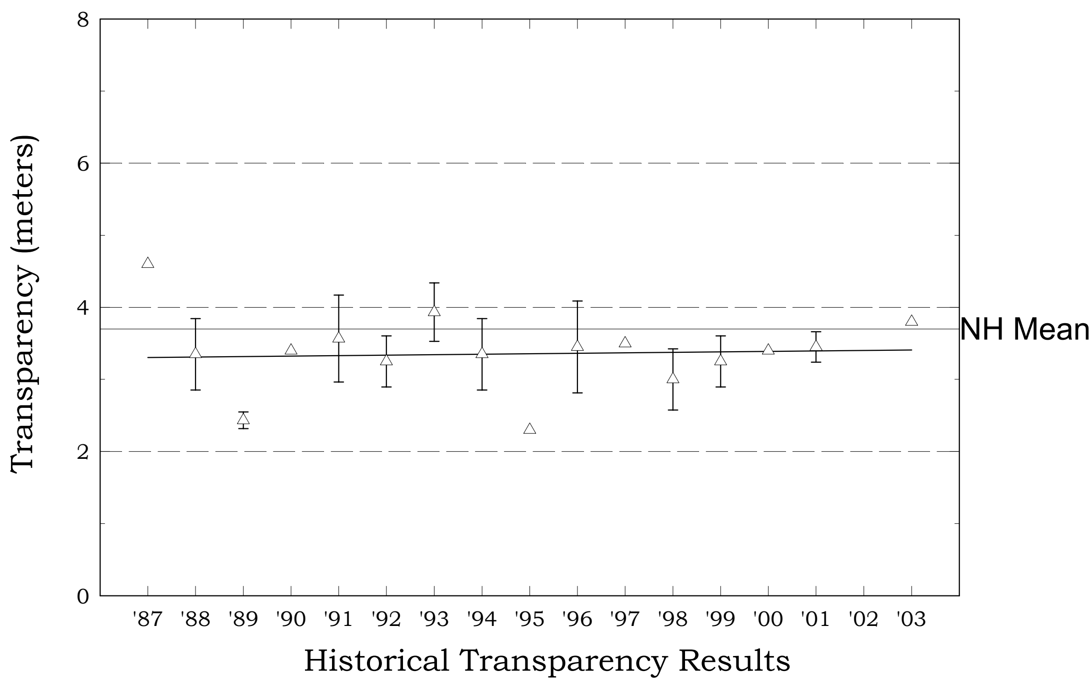




Lower Suncook Pond, Barnstead

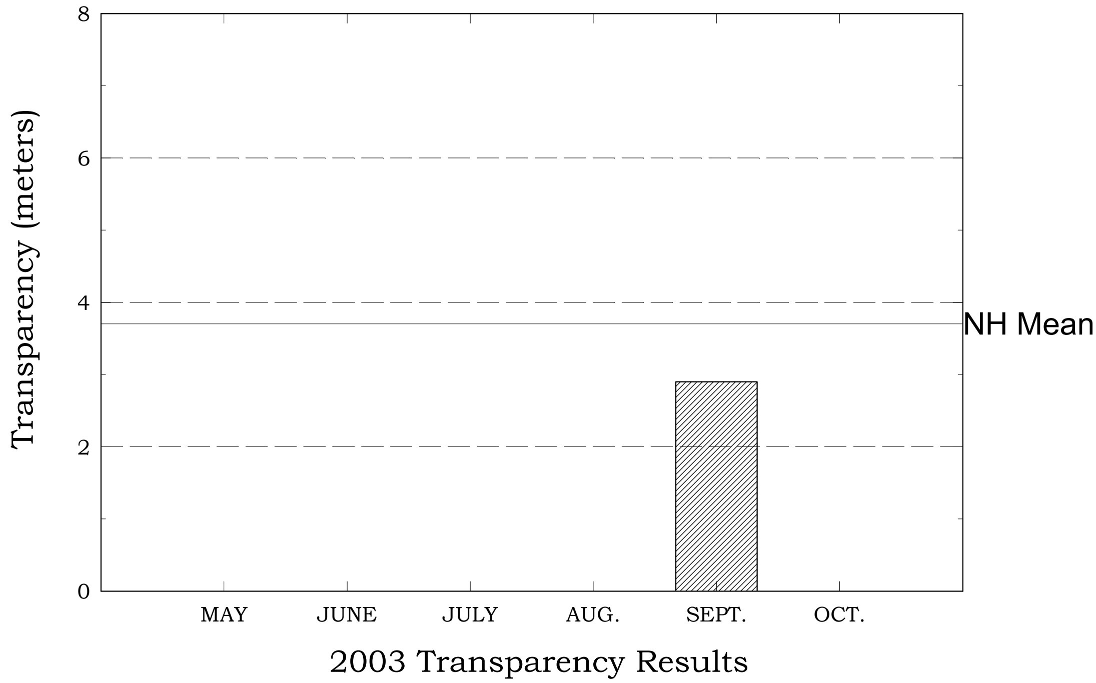
Figure 2. Monthly and Historical Transparency Results

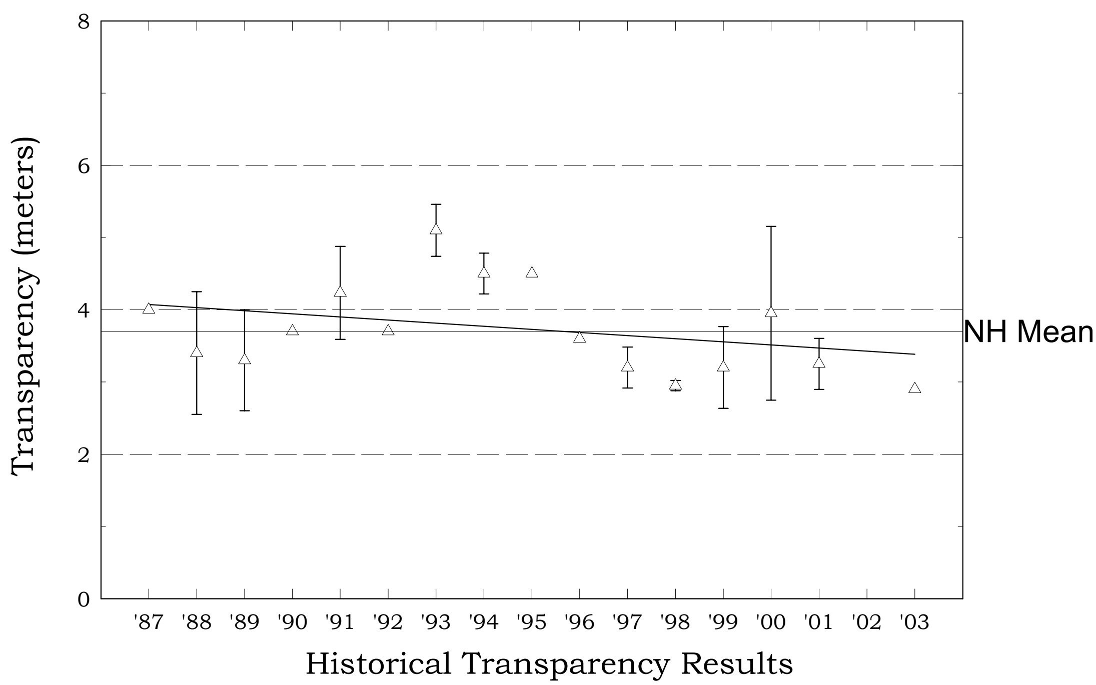




Upper Suncook Pond, Barnstead

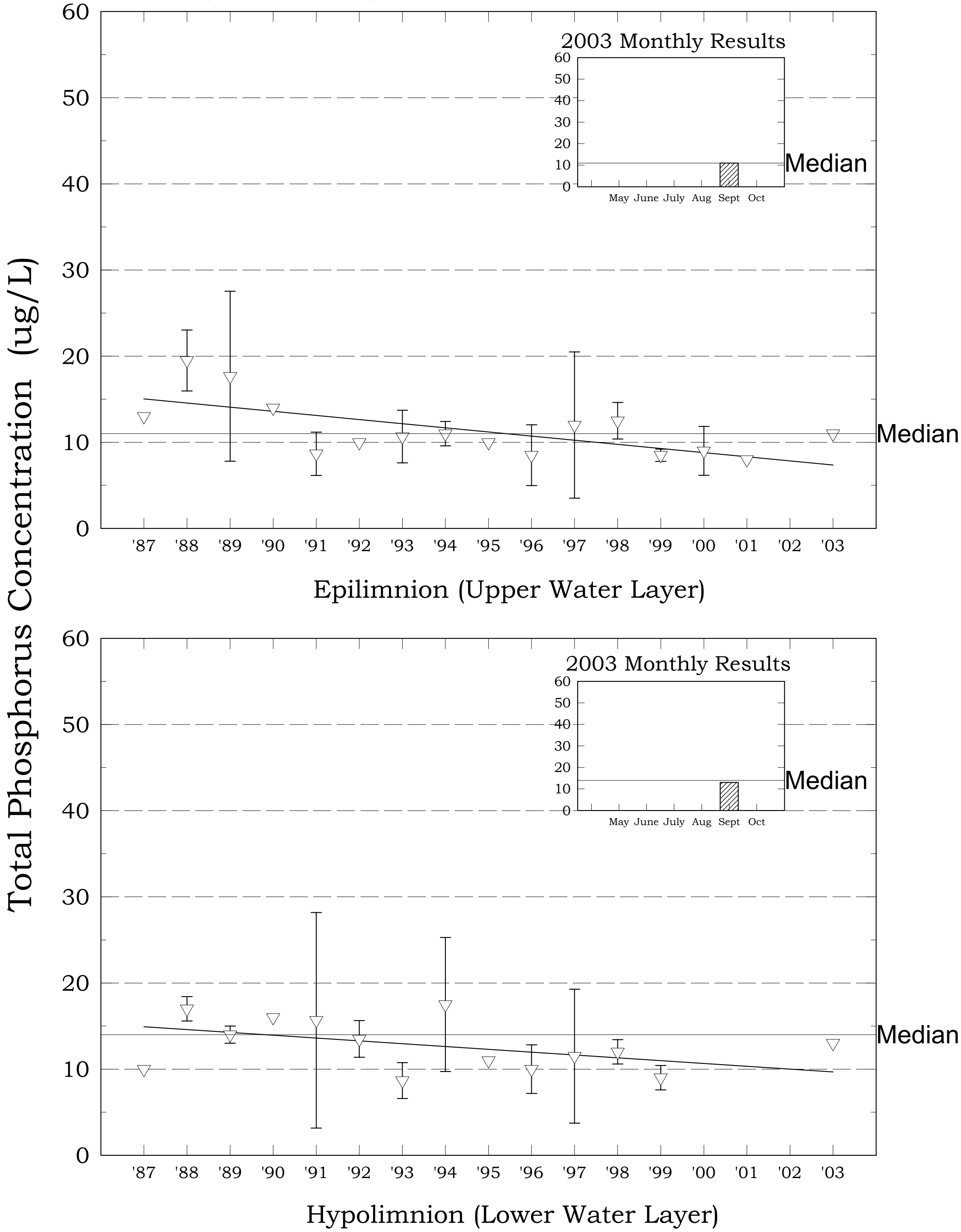
Figure 2. Monthly and Historical Transparency Results





Lower Suncook Pond, Barnstead

Figure 3. Monthly and Historical Total Phosphorus Data.



Upper Suncook Pond, Barnstead

Figure 3. Monthly and Historical Total Phosphorus Data.